Space Weather Technical Forecast

Issued on Thursday, 01 February 2024 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated R1/R2 Radio Blackouts. Possible glance from CME and slight chance of peak G1/Minor Storm conditions early day 1 (01 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low, with a peak flare of C4.5 from AR3567 peaking at 31/0829 UTC. There are currently nine sunspot regions on the disc, two of which are noteworthy and four of which are yet to be numbered. AR3567 in the northeast remains the largest and most magnetically complex region on the disc, with continued growth whilst maintaining a delta configuration on the main lead spot. There remains some uncertainty in the polarity of it's large trailing spot, with a possibility of a second delta region contained within. AR3565 in the northeast is the only other spot showing some magnetic complexity and increase in areal extent, this spot still comprises a north-south magnetic alignment in it's leading portion, affording it a beta-gamma configuration, now with a tenuous delta in the southernmost negative portion. Other spots on the disc have generally shown some slow development, but remain fairly simple and stable at this time. One new spot has become evident in the northwest, though this is small and simple.

A single CME was observed leaving the western limb shortly after midday on 31 Jan. Although the source of which is still not certain, after computation, it appears to be missing behind Earth.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, were indicative of a weak and waning coronal hole high speed stream. The solar wind fell from slightly elevated to slow-ambient levels, from around 460 to 390 km/s. The solar wind density trace was largely below average. The interplanetary magnetic field (IMF), Bt, was weak, below 5nT, with the north-south component, Bz, also varying weakly. The Phi angle was predominantly negative (towards the Sun). The net result of the above solar wind measures was Quiet geomagnetic activity (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is currently at slightly elevated levels following the M6.8 flare on 29 Jan from EX-AR3559, but remains well below the S1/Minor Storm threshold and continues to gradually decline.

GOES16 high energy (greater than 2MeV) electron flux was at normal background to moderate levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold but on a rising trend. At 01/0000 UTC the 24-hour integrated fluence observation was 2.87e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low, but with a chance of increasing to Moderate with isolated M-class flares, most likely from AR3565 or AR3567.

Solar Wind / Geomagnetic Activity: One CME features early in the forecast, though is now likely to have missed. There remains a small chance of a faint Earth glance from the flank early on 01 Feb. Solar winds are now slow-ambient after the previous coronal hole fast winds. The anticipated next HSS enhancement is from CH96/+ in the southern hemisphere, the bulk of

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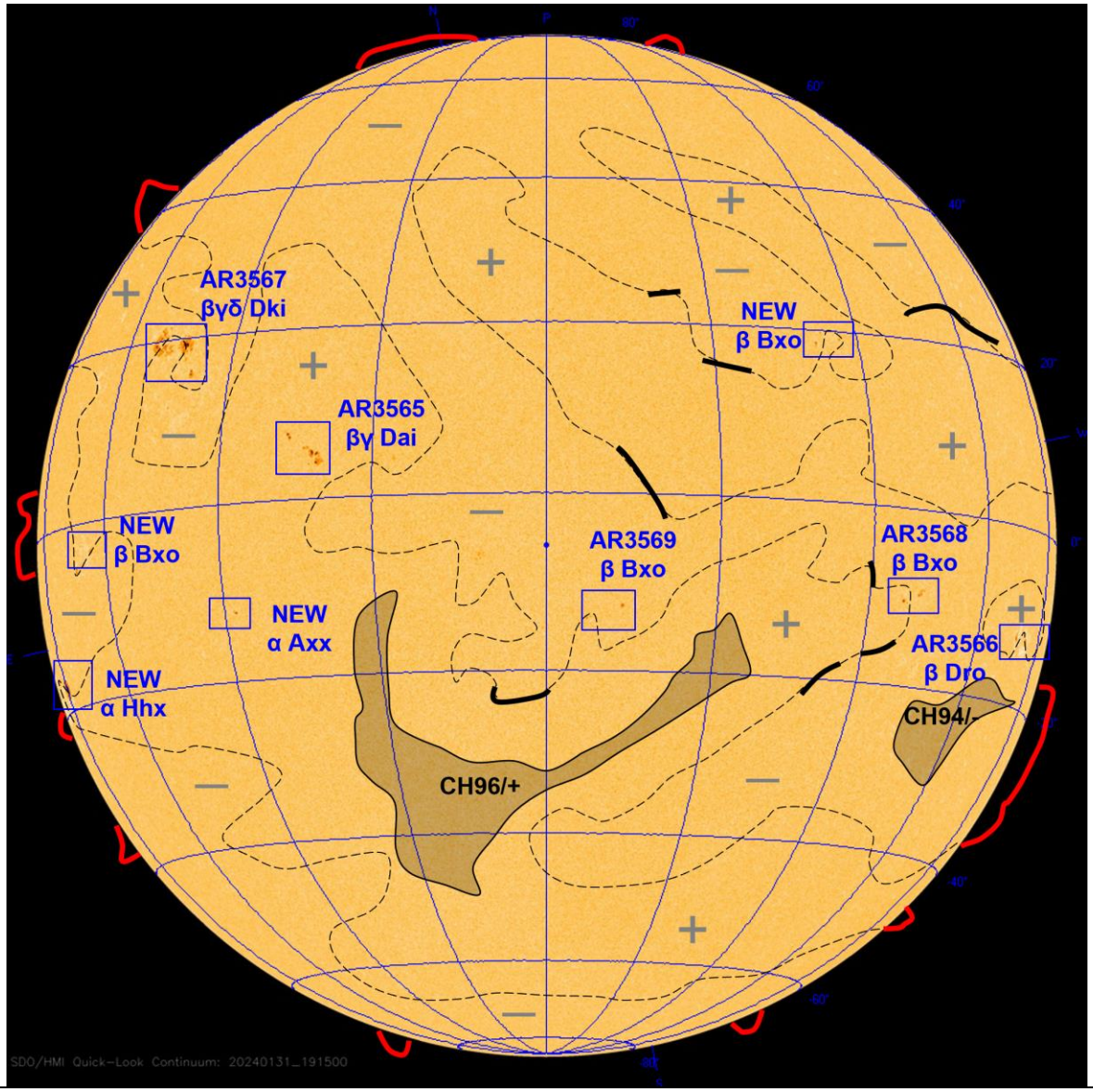
which is expected to be on day 4 (04 Feb), with solar wind speeds reaching 450-500 km/s.

Generally Quiet to Unsettled conditions are expected through the period, with a chance of Active intervals and a slight chance of peak G1 Minor Storm intervals early day 1 (01 Feb), should any potential arrival occur from the 29 Jan CME. There is a chance for isolated Active intervals on day 4 (04 Feb), due to the influence of CH96/+.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain below the S1/Minor Radiation Storm level, with a nominal risk of exceeding the S1 threshold during the period.

The high energy electron flux (greater than 2MeV) is expected to remain below High levels throughout the period, with exceedance of the Active threshold considered extremely unlikely.

Figure 1. Solar Analysis Valid 30/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one CME that currently features in the forecast, from the M6.8 from Ex-AR3559 at 29/0438UTC. MOSWOC Enlil modelling of this feature suggests the main bulk of the ejecta will pass well west of the Sun-Earth line with a slight chance of seeing a faint Earth glance from the flank early on 01 Feb.

A single CME was observed leaving the western limb shortly after midday on 31 Jan. Although the source of which is still not certain, after computation, it appears to be missing behind Earth.

Current solar wind conditions are indicative of waning coronal hole fast winds, with the source likely CH94/- or CH95/-. This influence is expected to continue easing through the period. The anticipated next coronal hole enhancement is from CH96/+ in the southern hemisphere. This coronal hole has two parts, a leading portion and a trailing portion which are tenuously linked via a faint narrow faint section. The arrival of the leading portion at Earth may be from late day 2 (02 Feb), though probably more likely on day 3 (03 Feb), with the trailing portion potentially arriving late day 4 (04 Feb) or later. This is a recurrent feature and compares well in terms of location and size to the previous rotation. Therefore solar wind speeds may once again peak 450-500 km/s.

Generally Quiet to Unsettled conditions are expected through the period, with a chance of Active intervals and a slight chance of peak G1 Minor Storm intervals early day 1 (01 Feb), should any potential arrival occur from the 29 Jan CME. There is a chance for isolated Active intervals on day 4 (04 Feb), due to the influence of the trailing portion of CH96/+.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/0753	Partial	AR3559	NW Limb	1150km/s	31/1800 UTC	Shock likely with bulk of ejecta expected to miss Earth.

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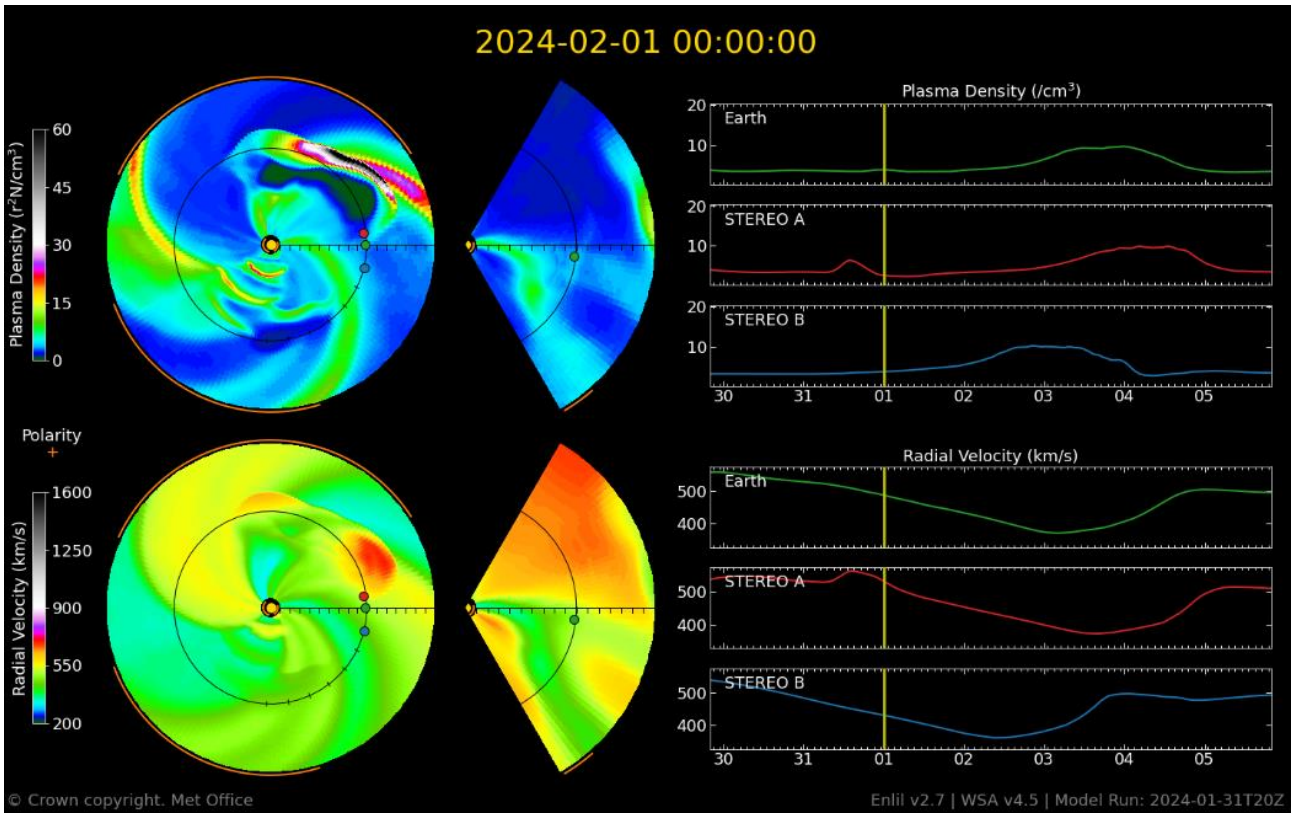
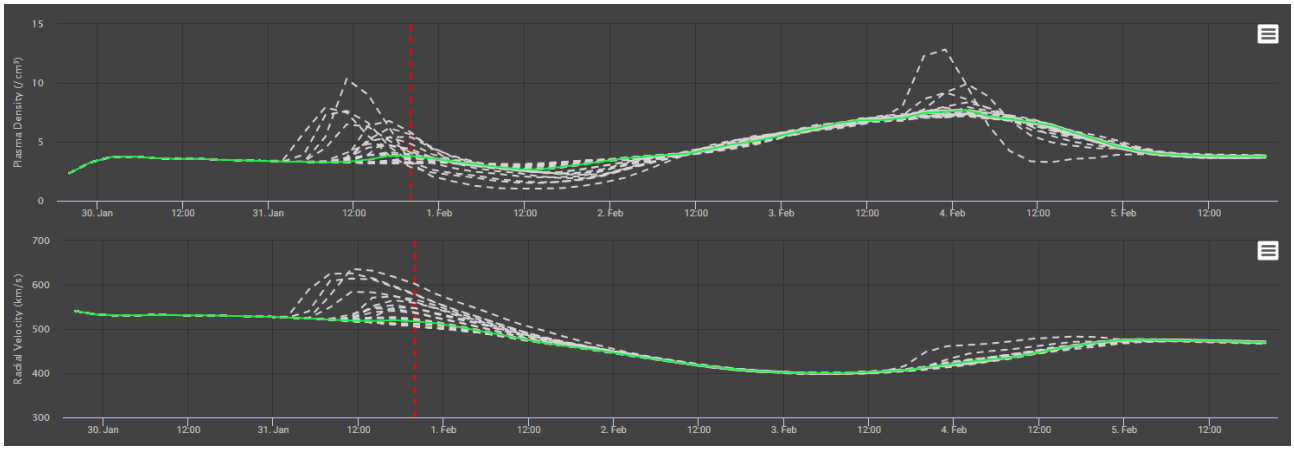
Figure 2: MOSWOC Enli and Enlil Ensemble





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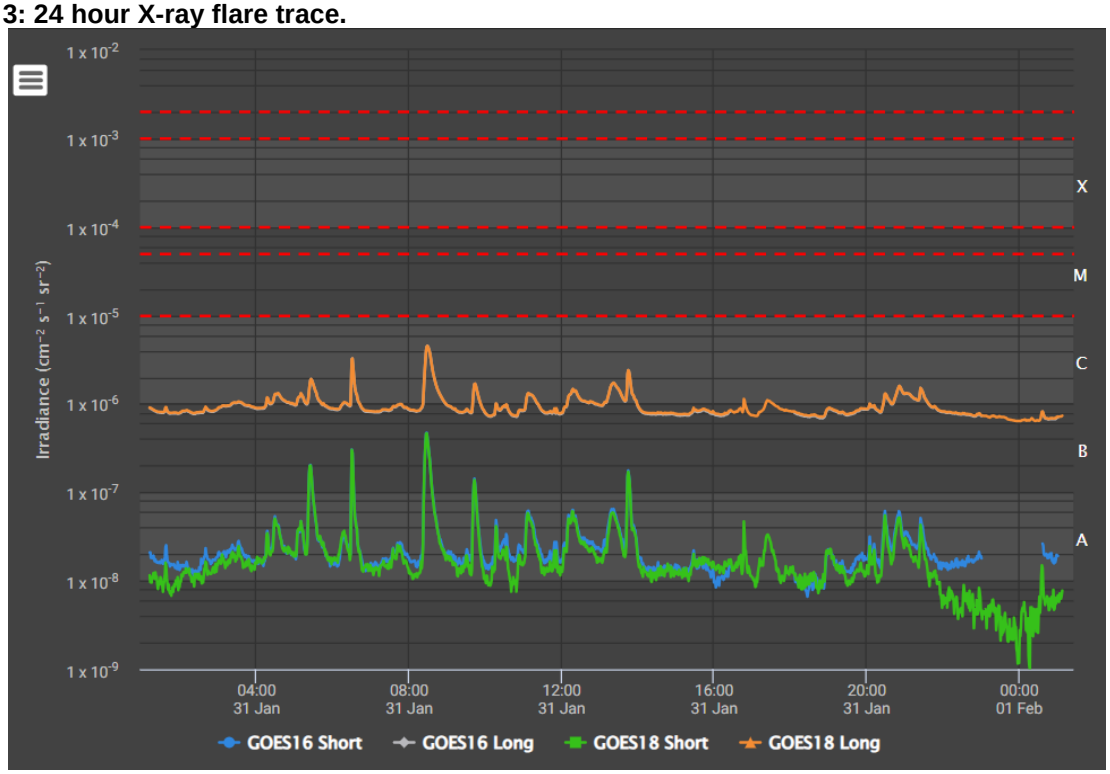
Radio Blackouts - X-Ray Flares:

Low activity is expected with a chance of isolated M-class flares increasing activity to Moderate levels. This is most likely from AR3565 or AR3567, both located in the northeast disc.

There are currently nine sunspot regions on the disc, two of which are noteworthy and four of which are yet to be numbered. AR3567 in the northeast remains the largest and most magnetically complex region on the disc, with continued growth whilst maintaining a delta configuration on the main lead spot. There remains some uncertainty in the polarity of it's large trailing spot, with a possibility of a second delta region contained within. AR3565 in the northeast is the only other spot showing some magnetic complexity and increase in areal extent, this spot still comprises a north-south magnetic alignment in it's leading portion, affording it a beta-gamma configuration, now with a tenuous delta in the southernmost negative portion. Other spots on the disc have generally shown some slow development, but remain fairly simple and stable at this time. One new spot has become evident in the northwest, though this is small and simple.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: 24 hour X-ray flare trace.



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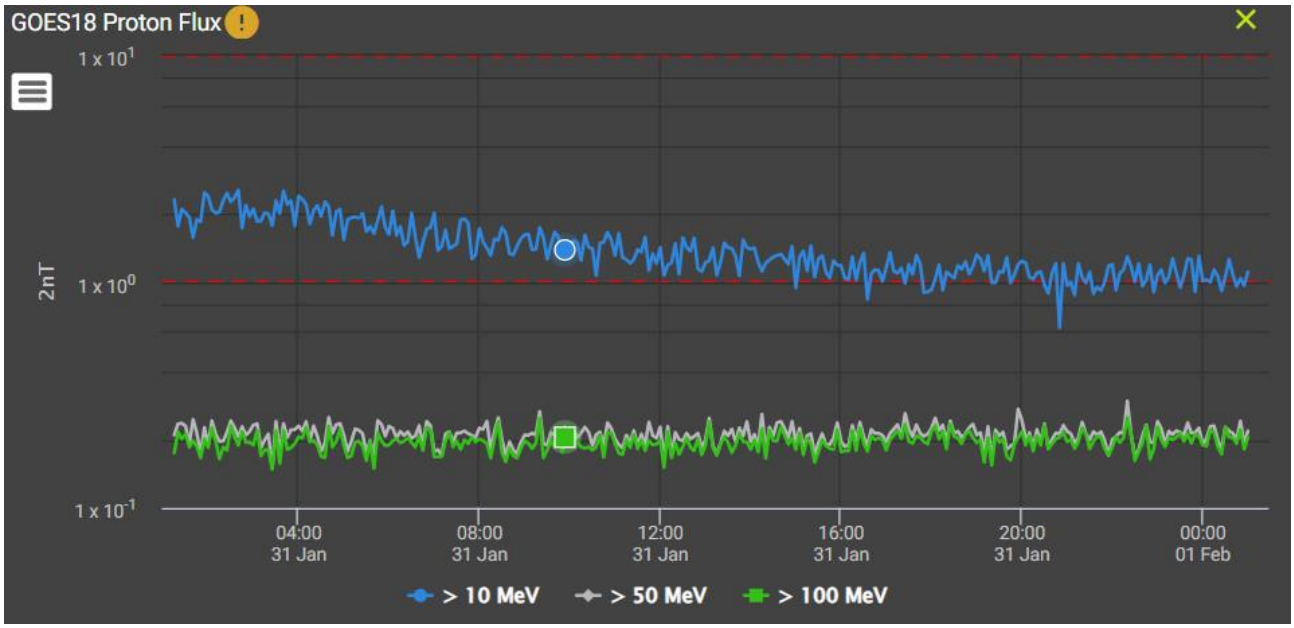
Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is currently at slightly elevated levels following the M6.8 flare on 29 Jan from EX-AR3559, but remains below the S1/Minor Storm threshold and continues to slowly fall. The risk of breaching the S1 threshold is now only a Slight Chance, should any notable flares occur from the spots on the visible disk.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	0	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: 24 hour high energy proton trace.



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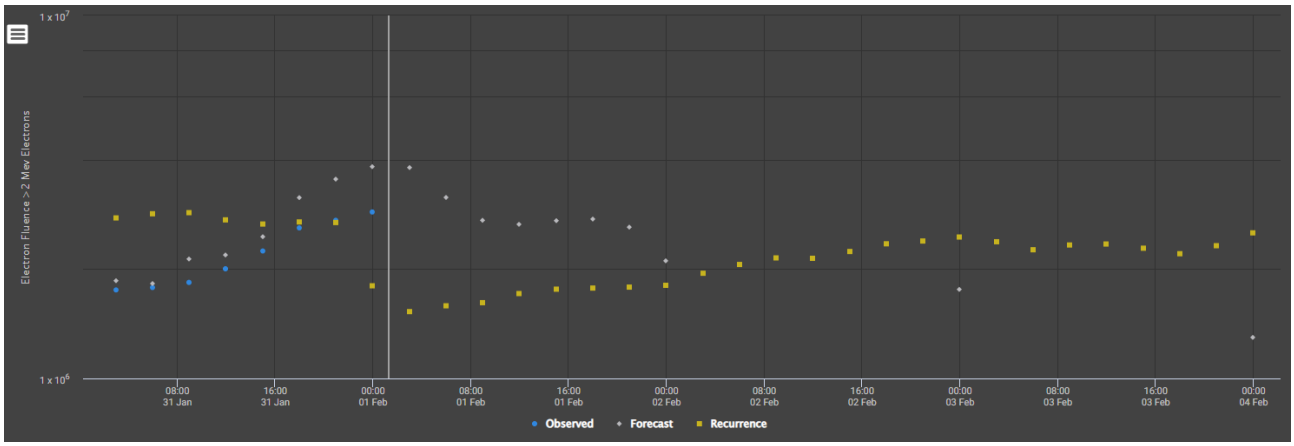
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has spent the whole of the past 27-day rotation below High levels, with an absence of significant drivers to alter this state given the expected lack of potent coronal hole fast winds. Persistence suggesting significant electron flux is very unlikely.

MOSWOC REFM's projections and persistence values both imply a continuation of the current background state, this is considered good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

Figure 5: MOSWOC REFM fluence observations, forecast and recurrance.



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